A Level Computer Science

Exam Style Questions

Unit 1.4.1

Data Types

Binary Representation, Subtraction & Normalisation
MEGA Compilation Paper

Name		Date	

Score	Grade
/ 100	

Question 1

a) The floating point binary number 010011 011 consists of a 6-bit mantissa and 3-bit exponent, both represented in two's complement. Convert the number to denary, showing your working.

[3]

b) Show the denary number −5.25 in floating point binary form representing the mantissa and exponent in two's complement, using as few bits as possible. Show your working.

[4]

c) Show how the binary number 01011110 is represented in hexadecimal.

[1]

d) Show how the denary number −87 is represented in sign and magnitude binary.

[2]

e) Complete the following binary subtraction. Show your working.

```
01001001-
00101111
```

[2]

f) Show how the hexadecimal number 9B is represented in denary.

[2]

Question 2

a) Describe why two's complement may be preferable to sign and magnitude.

[2]

b) Demonstrate subtraction in binary using 8-bit two's complement using the equivalent of the denary calculation 47-23. You must show all working.

[4]

Question 3

a)

i) Change the denary number -89 into a two's complement, 8 bit binary number.

[1]

ii) Change the denary number -72 into a two's complement, 8 bit binary number.

[1]

b) Add the two binary answers which you obtained, using 8 bit arithmetic.
You must show your working.

[2]

c) Explain why your answer to the addition sum is wrong.

[2]

Question 4

Show a representation of denary -119 in 8-bits using:

a) Sign and Magnitude

[1]

b) Two's Complement

[1]

Question 5

A real binary number may be represented in normalised floating point binary notation, using 4 bits for the mantissa followed by 3 bits for the exponent, both in two's complement binary.

a) Convert the denary value 1.75 to normalised two's complement binary in the format described. You must show your working.

[4]

b) Convert the following number to denary. You must show your working.

```
0110 111
```

[3]

Question 6

A floating point number is represented with a mantissa of 8-bits followed by an exponent of 4-bits, both in two's complement.

```
00011010 0010
```

a) Identify whether or not the number is normalised.

[1]

b) State how you arrived at your answer to part a).

[1]

Question 7

Convert the denary number −19 to an 8-bit number using:

a) Two's complement representation.

[1]

b) Sign and Magnitude representation.

[1]

Question 8

a) The number below is represented in floating point format with a 5-bit mantissa in two's complement followed by a 3-bit exponent in two's complement. Calculate the denary value of the number, showing your working.

`01001 010`

[3]

b) The numbers below are represented in floating point format with a 5-bit mantissa in two's complement followed by a 4-bit exponent in two's complement. Normalise the numbers shown below, showing your working.

i) `00011 0010`

[2]

ii) `11100 0110`

[2]

Question 9

Using two's complement convert the denary number –43 into an 8 bit binary number. You must show your working.

[2]

Question 10

Convert the denary number -52 into an 8-bit binary number using two's complement.

[2]

Question 11

a) Convert the denary number –8 to:

i) An 8-bit sign and magnitude binary number.

[1]

ii) An 8-bit two's complement binary number.

[1]

b) A computer represents floating point binary numbers using a 6-bit mantissa and 4-bit exponent, both using two's complement.

Add the following three numbers together and give the answer in the format described. You must show your working.

```
010100 0010
011000 0001
100010 0010
```

[6]

Question 12

A real binary number may be represented in normalised floating point binary notation using 4 bits for the mantissa followed by 4 bits for the exponent, both in two's complement binary. The following binary numbers are in the format described.

a) Calculate their denary values. You must show your working.

i) 0101 0110

[3]

ii) 0100 1110

[3]

b) A real binary number may be represented in floating point binary notation using 7 bits for the mantissa followed by 5 bits for the exponent, both in two's complement binary.

i) State which of the binary numbers P and Q is normalised. Give a reason for your answer.

```
P = 101100110001
Q = 110100110011
```

[2]

ii) The binary number R is not normalised. Write the normalised form of R. You must show your working.

```
R = 000110100101
```

[3]

Question 13

A real binary number may be represented in normalised floating point binary notation using 5 bits for the mantissa followed by 3 bits for the exponent, both in two's complement binary. The following binary numbers are in the format described.

a) Calculate their denary values. Show all working.

i) 01100 011

[3]

ii) 10100 111

[3]

b) Write the denary number +3.5 as a normalised binary number in the format described in a).

[3]

Question 14

Two floating point numbers are shown below. Calculate the answer of the second number subtracted from the first. You must show your working and ensure your answer is normalised.

```
01001100 0011 - 01001010 0010
```

[5]

Question 15

a) Represent the number 55 in normalised floating point binary notation, with the mantissa and exponent both in two's complement binary, using as few bits as possible.

[2]

b) Represent the number 55 in normalised floating point binary notation, using 8 bits for the mantissa followed by 8 bits for the exponent, both in two's complement binary.

[2]

Question 16

Variables in programs contain specific types of data. Show the denary number $-2\frac{5}{8}$ as a floating-point binary number with a 6-bit mantissa and 4-bit exponent, both stored using two's complement representation.

[3]

Question 17

The following floating point binary number is represented using 7 bits for the mantissa and 4 bits for the exponent, both using two's complement.

```
Mantissa   Exponent
0100101    0100
```

Convert the number to denary, showing your working.

[3]

Question 18

a) Convert the denary number 188 to an unsigned 8-bit binary number.

[1]

b) Convert the denary number −44 to an 8-bit binary number with sign and magnitude representation.

[1]

c) Convert the denary number −44 to an 8-bit binary number with two's complement representation.

[1]

Question 19

Express the denary number –43 in binary using 8-bit two's complement representation.
Show your working.

[4]

END OF QUESTION PAPER